center was not identified, however, in any other observations reaching this office. During the night of the 13th–14th squally weather accompanied by southwest to west winds of force 7–8, but no depression of the barometer, occurred in the neighborhood of 12°–13°N., 96°–97°W.

Typhoons.—On August 29 a typhoon was reported as organizing about midway between the Marianas and the Philippines. On the 31st it lay south of Naha, when one Japanese ship reported a gale of force 9 in the vicinity to the Tokyo Meteorological Office. The typhoon began to recurve from this point and on September 1 lay between Naha and the China coast, whence it pursued a northerly and later a northeasterly course, until it was lost to observation near the coast of Kamchatka on the 7th. It attained full hurricane force on the 2d, if not earlier, when 100 miles or so east of Shanghai. The American S.S. *Golden Horn* (Capt. J. B. Knowles, master; Second Officer E. M. Black, observer), Moji to Shanghai, encountered winds of force 12 from northeast and east-northeast from about 8 p.m. of the 2d until after 1 a.m. of the 3d, and was in the typhoon's vortex from 2 to 3 a.m. of the 3d, lowest barometer 28.12, with a dead calm prevailing at 2:30 a.m. The observer commented upon the tremendous seas experienced prior to entry into the vortex, and upon the abnormal lessening and absence of confusion of the seas within the center. "Birds of many different types", he said, "littered the decks; over 300 were counted on the bridge alone. All were exhausted, even the Arctic tern, which is a very strong bird." The *Golden Horn* was then in about 35 fathoms of water. The west-northwesterly winds which followed the center did not reach their highest force (10) until 7 a.m. On the 5th fresh gales (8) from this storm were reported along both east and west coasts of central Japan, and strong gales (9) on the 7th in the Okhotsk Sea.

On September 9 a depression originated southeast of Yap. It moved along a generally northwest course until the 17th when, east of Taiwan, it turned northward across the Eastern Sea, then suddenly swerved across southern Japan and died out to the eastward on the 20th. This disturbance appears to have been of considerable depth on the 18th and 19th, but the Tokyo reports show no wind forces higher than 9 occurring in the Eastern Sea on those dates.[1]

Other minor disturbances of the Far Eastern tropics were (1) a depression of the 13th-18th which, originating near the western Marianas, moved northward past the Ogasawara Islands and caused gales of force 9 near 40° N., 150° E.; and (2) a disturbance of unknown intensity which gathered east of the Philippines on the 8th and moved northwestward into the northern part of the South China Sea, where, with slow westward progression, it continued during the 10th to 15th.

Fog.—At least 17 days with fog were reported along the California coast between San Diego and Eureka. Between Eureka and Vancouver Island fog occurred on 13 days. Along the northern steamship routes it was observed on 1 to 5 days, the localities of most frequent occurrence lying south and southwest of the Aleutian Islands.

TYPHOONS IN THE FAR EAST, SEPTEMBER 1933

By Rev. C. E. DEPPERMANN, S.J.

[Assistant Director, Philippine Weather Bureau, Manila, P.I.)

(1) *September 10.*—There are indications that this small but interesting typhoon started in mid-China Sea about September 8 and then traveled northeast to the west Balintang Channel, just northwest of northern Luzon. As usual, it was on the intertropical front (hereafter called more briefly the "tropical front") between the southwest monsoon and the trade wind. When definitely located on September 10, it had recurved westward and continued in this direction until it reached the Gulf of Tonking, where it filled up and disappeared. Why? The southwest monsoon stream had divided, the main portion crossing the Philippines to enter the typhoon of September 11; the rest was almost entirely blocked from reaching the typhoon by the mountain ranges of east Indo-China.

(2) *September 11.*—This typhoon started on the eastern branch of the tropical front. On September 9 there were strong suspicions of some depression passing between Guam and Yap, since the barometers of these two stations fell considerably (1.5 to 2 mm is "considerable" for these tropical stations). The southwest monsoon in typhoons still in the growing stage seems to occupy a V-shaped sector pointed northward. A little consideration will show that the center of the disturbance could already have passed the line (NE-SW) joining Guam and Yap and yet give no wind shift to southwest at the more southerly station, Yap. In fact, winds and cloud directions may seem to indicate a disturbance still to the south of Guam. This shift to southerly winds did not come until the 10th, when the front passed through Yap. On the 12th, as the typhoon came nearer to the Philippines, the front from the typhoon to the islands was very neatly given by the wind directions of 2 ships, 1 above and 1 below the front. It may be noted in passing that an almost infallible sign of a typhoon to the east of the islands, even before any fall of the barometer, is the presence of squally winds from the southwest sweeping through the islands on their way to feed the typhoon. On nearing the islands, the typhoon gradually recurved northward without touching them. The situation on September 17 is quite instructive. The typhoon was just below Ishigakajima in the Nansei group. From thence the front extended toward Guam, with trade wind to the east and southwest monsoon to the west. Again, from the typhoon over to mid-Indo-China, there was a sharp front between strong southwest monsoon winds and equally strong northerly winds from the Formosa Channel. Many ship reports from the China Sea enabled us to mark this front with the sharpness almost of a knife. In fact, on this front, close to western Luzon, a "baby" typhoon started, with barometers down to about 746 mm and wind force 10 to 11. Speaking rather timidly from observations only of the present year, this north-pointing V-sector of the southwest monsoon, with trade wind to the east and northerly Asiatic air to the west, seems to be typical of typhoons which curve northward and are soon to enter the eastward-moving circulation. The very moist southwest monsoon also seems to be the "feeder" of the typhoon by reason not of temperature differences but of the vast energy it can release by condensation of its ample supply of water vapor (cf. Refsdal, Der Feuchtlabile Niederschlag, Geofys. Publ., vol. V, no. 12, p. 62, ff. and other Norwegian publications). By the 17th, the typhoon had increased much in intensity, passing over Ishigakajima, which station was temporarily disabled, giving no more weather observations until the 20th. The storm continued northward until about 100 miles east of Shanghai. The *President Cleveland* just about this time (Sept. 19) was close to the center, and reported 726.7 mm, wind force 12, tremendous sea. Two Japanese ships sent out SOS. As far as could be ascertained from newspaper reports, only one of these

[1] For a detailed account of this storm, see the following article on typhoons by the Rev. C. E. Deppermann, S.J.

ships was accounted for some days later. Already on the 18th the cessation of strong winds in the China Sea indicated that the storm had become occluded, with the southwest monsoon forced out, leaving the typhoon to join the east-moving circulation and the front between polar air and the trades. In fact, with decreasing intensity, the typhoon on the 19th while in the Yellow Sea turned quite sharply eastward, cutting across southern Chosen (Korea) and lower Japan, curving to the southeast on the 22d, and passing beyond our maps.

(3) *September 19.*—It is just possible that the "baby" typhoon mentioned in (2) lazily traveled northward until it showed itself more emphatically on the 19th just northwest of northern Luzon, but there are no data to confirm this except rather strong winds in northern Luzon on the evening of the 18th. However, after the southwest monsoon had broken connection with the typhoon up north, the trade wind surged in with a rush on the 19th through the channel between Luzon and Formosa and, meeting the southwest monsoon still in the China Sea, either pushed the "baby" typhoon westward, or else started a new typhoon along the now rebuilt tropical front. This typhoon passed rapidly west-northwestward to just below Hong Kong, and dissipated soon afterwards when it entered the mainland.

(4) *Sept. 26.*—This storm was first discerned as usual between Guam and Yap on the tropical front, along which it traveled in a westnorthwest direction. As the storm progressed, the front did not as usual move quite rapidly through the Philippines northward, but remained near the southernmost end of the Islands, indicating that the typhoon was not fed by a very strong stream. In fact, as the typhoon passed through northern Luzon, the southwest monsoon sector was found to be very narrow and the typhoon very mild, doing practically little damage. In the Islands, the lowest barometer seems to have been only 745 mm. Contrary to what is often asserted in books, this typhoon though so small had no difficulty in surmounting the mountain ranges of Luzon, over a mile high. Why did not this typhoon recurve? For some days previously a large high pressure area had built up over China and Japan, forming a front (the polar front we may call it) between north Asiatic air and the trade wind all the way from east of northern Japan down to Indo-China; but the trade wind divided into two parts near the Nansei (Loochoo) Islands, one stream going northeast, the other roughly southwest. The typhoon was caught in the more southerly stream and hence made its way gradually toward the polar front which it apparently seemed to reach near the Philippines. While in the China Sea indications are that the southwest monsoon was squeezed out entirely, and the typhoon progressed along the polar front in a westerly direction until at the time of writing (Oct. 3), it passed very close to Phulien in Indo-China, having increased slightly in intensity.

In conclusion, it may be added that in following fronts through the Philippines, the writer has been greatly aided by the direction of motion of the lower clouds. Quite early the Manila Observatory recognized the value of such observations as an aid in locating the center of a typhoon (usually on the line perpendicular to the lower cloud direction), and hence this information has been included in the telegrams sent by our weather observers to the Manila central station. The ground winds are much influenced by topography and by the land and sea breeze, but usually the lower clouds are free from these influences and give quite faithfully the direction of the general air stream. This is a marked help when fronts are weak, as often happens in the islands, and their detection through rain areas, temperatures (almost hopeless in the Tropics!) and barometric pressure proves illusive. Since the islands are narrow, it has also been found necessary to draw half-millimeter isobars to bring out many salient facts. The writer is convinced that if all the observatories in the Far East, and for that matter throughout the world, reported lower cloud directions, the tracing of general air streams and consequently of fronts, would be greatly facilitated.